National Aeronautics and Space Administration

Nebula Cloud Computing Project: Background, Technology, Operations, Challenges, and Status

Office of the Chief Information Officer

*NASA IT Vision: The NASA IT Organization is the **very best** in government*

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January 5, 2012

Nebula Background

- Nebula cloud project evolved from a web app platform development project in late 2009
  - » Needed scalable infrastructure w/ isolation mechanism
  - » Choices were limited
  - » Timing was right for IaaS development project
- Project funded incrementally
  - » Combination of Center & OCIO investments in addition to usage fees from two customers
- From the start, Nebula envisioned as a community open source development project
  - » In July 2010, Nebula's Nova Compute Controller became one of two foundational components of Openstack

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Nebula Background (Cont'd)

- Nebula operated in Alpha and extended Beta phases with pilot users across NASA from April 2010 to June 2011
- In July 2011, the NASA Science Mission Directorate (SMD) acquired exclusive use of Nebula for 5 months to conduct an evaluation with science workloads

Nebula Components

- 70 combined compute-storage nodes (commodity gear)
  - » Dual 2.8+ GHz Nehalem and Westmere processors
  - » 96 GB RAM, 12-24 TB's of DAS each
  - » Two 10 GbE NICS & two 1 GbE NICs
- Arista network switches
- Two containerized data centers managed as a single cloud (one at ARC; one at GSFC)
  - » Communications via NASA WAN
- Implementing Openstack Diablo (4th release)
  - » Ubuntu OS (Oneiric); KVM hypervisor
- Standard VM Images: Ubuntu, CentOS

Nebula Configuration

- FISMA low accreditation today
- Authentication via Nebula-specific LDAP services today
- Using NAMS for account management
- Project-specific VLANs set up for multitenant isolation
- Bastion host used for access to instances within VLAN
- Not using SAN or NAS appliances
- Default is <u>no</u> permanent volume storage for instances
- Permanent volume storage can be allocated by users
- 6 initial instances sizes, including new full-node instance
- Process for allocating public IPs

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Nebula Operations

- Both Nebula regions operated from ARC, with support from GSFC
- Monitoring of key infrastructure components performed using Nagios and other tools
- Periodically run native OS security scans and monitor logs
- Can't expect to operate and maintain a configuration at scale without heavy reliance on automation tools (e.g., Chef, Puppet)
- Need ops team with strong Linux and networking skills
  » Knowledge of python language recommended
  » Helps if ops team members have some dev experience

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Nebula Challenges

- Making the transition from a small development project to an Agency-level service
  - » Achieving FISMA accreditation with limited guidance
  - » Integrating service capabilities with existing Center and Agency processes; alignment with existing policy
  - » Adopting the operational discipline and processes necessary to support broad use
  - » Identifying a suitable funding / cost recovery approach for sustained operations
- Promoting a computing approach that is still new to most potential users

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Nebula Status

- SMD evaluation of Nebula ended Nov. 30
- Project leadership and NASA OCIO in discussions with SMD on a phase 2 investment that would address needed improvements identified during evaluation
- In progress:
  - » Upgrading to Diablo release of Openstack, including Swift object store service
  - » Implementing processes and capabilities needed to achieve FISMA Moderate status

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OpenStack

- Nebula team vision of an open source community-developed cloud stack is in the process of being realized
  - » In just 18 months, the Openstack community has grown rapidly and has participants around the world
- Community open source development provides an exciting new avenue for NASA collaboration
  - Today, Nebula is the only project within NASA approved for community open source development
  - Based on the Nebula experience, Agency policy changes are currently being pursued that will allow future projects to engage in this form of software development
- Nebula, via Openstack, provides a great example of the potential of public-private collaborations using the community software development model

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OpenStack Community